

# Naked Surgeons? The Debate About What to Wear in the Operating Room

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There has been recent controversy regarding recommendations and regulations concerning operating room attire. We performed a nonsystematic literature search regarding operating room attire and surgical site infection (SSI) risk. Much of the literature relies on air sampling and culture of operating room equipment but does not present evidence regarding effect on SSI risk. There is no evidence regarding SSI risk related to operating room attire except for sterile gowns and the use of gloves. Naked surgeons shed fewer bacteria into the operating room environment than ones wearing scrub suits.

**Keywords.** operating room; surgical site infection; attire; contamination; head gear.

It has always been difficult to balance the “evidence” part of “evidence-based medicine” and pragmatism. Sometimes the evidence is weak. Sometimes a strict adherence to the evidence would lead to implausible and unrealistic actions. Sometimes there are other factors to consider beyond focusing on mortality or adverse events. Therefore, it is reasonable, at times, to take a balanced and pragmatic approach when drafting prescriptive recommendations about how to care for patients. Does this framing not apply to operating room policies?

In 2014, the Association of Perioperative Nurses (AORN) issued new guidelines about, among other things, headwear in the operating room [1, 2]. They recommended that “a bouffant hat should be worn to cover all of the hair, scalp, and ears to minimize skin and hair shedding and protect surgical patients from bacteria.” A virtual debate ensued in what some have suggested was a figurative representation of the debates that happen daily in the operating room: doctors and nurses arguing in the name of what is best for the patient [3, 4]. The American College of Surgeons responded with a statement that included the notion that “the skullcap is symbolic of the surgical profession” and the medical blogosphere erupted, even spilling over into popular media outlets [5]. Of note, a similar response was seen in the United Kingdom following the introduction of a “bare below the elbows” policy about 10 years ago [6–9]. As 2 surgical trainees and a senior surgeon, we ask: Where

does the truth lie? What *truly* is best for patients, patient safety, and hospital employees? If we dive into the supporting evidence, do we reach the same conclusions? Should we consider factors in addition to theoretical bacterial shedding to guide operating room protocol aimed at decreasing wound infections?

## WE ARE NOT BEYOND SELF-DEPRECATION

Sometimes, practices that are shown to bring about improvement are not adopted in a timely manner. There is a tradition—particularly in surgery—of tolerating delays between the publication of convincing evidence for infection control methods and the introduction of those methods into practice. In the 1840s, Ignaz Semmelweiss and Oliver Wendell Holmes presented evidence that handwashing could reduce infection, but it was not until Lister popularized the practice in the 1860s and 1870s that it caught on. It took nearly 30 years for handwashing to even be accepted as “good practice” [6]. In fact, the very adoption of “evidence-based medicine” followed a similar timeline: First described by Cochrane in the 1970s, it was not widely accepted and taught until the 1990s [10–12]. In another example, the use of surgical gloves, although shown to decrease infection by Dr William Halstead’s senior resident, Dr Bloodgood (the irony of his name does not escape us) in the 1890s, was not commonplace until the 1920s. Again, a lag of 30 years. However, the reasons cited for not wearing gloves early on tell a subtle but important story: The gloves, which were admittedly cumbersome and thick at the time, impaired surgeons’ “sense of touch” [13]. This struggle between sacrifices in functionality and potential improvements in infection control continues to the present debate.

In contrast, there are other practices that are adopted but not clearly shown to bring about improvement. Physicians—and surgeons are no exception—have the habit of regimenting these practices based on dubious evidence. The use of masks,

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impermeable surgical drapes, hospital-laundered surgical scrubs, and modern surgical gowns—all staples of infection control in the operating room—were not guided by clinical studies [14]. As with many practices in medicine, behaviors passed down from one generation to the next become common practice and are subsequently mandated by governing bodies [15, 16]. In fact, the argument for many of these practices is as much about protecting healthcare workers from their patients as it is protecting patients from healthcare workers' germs.

## WHERE DO GUIDELINES COME FROM—AND WHY FOLLOW THEM?

Many organizations deliver guidelines for conduct in the operating room, namely, the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), the Occupational Safety and Health Administration (OSHA), and AORN. Of these, the AORN guidelines provide far greater detail about what we should and should not be wearing in the operating room, how to launder operating room garments, and how to wear them. The recent WHO guideline, using strict Grading of Recommendations, Assessment, Development and Evaluation (GRADE) evidence criteria, simply recommends a sterile gown that can be either disposable or reusable [17]. The CDC guidelines from 1999 discuss the literature and describe current practices, admitting that there is little or no good evidence in this area except for use of gloves [18]. The British National Guidelines similarly recommend wearing a “sterile gown” and to “consider wearing 2 pairs of sterile gloves”—and that is the extent of their surgical attire mandates [19]. But guidelines are recommendations only; policies—national, state, or hospital specific—are enforceable. The evolution of guidelines to become policies, at least in the United States, is as convoluted as evaluating the evidence itself. State departments of health and the Joint Commission, the 2 most important regulatory bodies, expect hospitals to have the processes in place to develop their own policies around operating room attire (Kathy Ostrowski, oral communication, March 2017). If those policies follow a national guideline, there are no further questions. However, when these are different from established guidelines—such as those from CDC or AORN—it raises eyebrows and leads to further inquisition as to the rationale of those policies. No hospital administrator wants to raise the eyebrows of these regulatory bodies; the easier solution is to adopt established guidelines.

Hospital infection control committees are often composed of clinicians and administrators with many other demands. This, in turn, means that societies' guidelines are used as proxies for “expert opinion” even by experts themselves, since researching and summarizing the current state of medical knowledge is resource and time-intensive. Even though policy is drafted by hospitals, the democratization of decision making down to the hospital level has the effect of making guidelines into decrees which can be refuted but only at a high cost.

## CAN'T WE ALL JUST GET ALONG?

Despite the debates mentioned above, there are areas of agreement. We all want what is best for patients while preserving a supportive working environment. All agree that it behooves the system to reduce the incidence of surgical infections. All agree that germs (namely, bacteria) cause infections. All agree that patient characteristics (diabetes, age, comorbidities) contribute to the risk of developing an infection. With that in mind, and to understand the debate itself, it is important to understand some of the history and context behind our efforts at infection control.

After Louis Pasteur and Robert Koch provided convincing evidence for the germ theory, the idea of reducing bacterial counts became a proxy for infection control [20]. This led to the focus on reduction of airborne bacteria, either by preventing the bacteria from becoming airborne (eg, a face mask) or by rapid removal of the bacteria after they have already become airborne (eg, positive pressure rooms). Moreover, early studies identified the “skin squame” as the vehicle by which infectious organisms can travel from person to person in the hospital and particularly in the operating room. The assumption, therefore, was that more shedding of skin squames translates to more bacteria in the operating room air and thus to a higher risk of surgical infection. Therein lies the rub. (“Therein lies the rub” is actually a misquotation from Shakespeare's Hamlet when the titular character says, “Ay, there's the rub.” We decided to stick with the colloquial—though incorrect—form.)

In a review of the evidence linking infectious risk and staff behavior, Birgand and colleagues concluded: “Published data about the impact of operating-room behaviors on the risk of infection are limited and heterogeneous. All studies exhibit major methodological flaws” [21]. With that as a backdrop, let's discuss some specifics.

## THE RIGHT TO BARE ARMS

On the topic of covering the arms, AORN recommends: “When in the restricted areas, all nonscrubbed personnel should completely cover their arms with a long-sleeved scrub top or jacket” [1]. Interestingly, AORN's recommendations and the United Kingdom's NICE's requirements are contradictory: As above, AORN recommends wearing a “long-sleeved scrub top or jacket,” whereas NICE's policy is “bare below the elbows” [1, 22]. The fact that 2 large, guideline-producing bodies would recommend completely opposing practices under the rubric of evidence-based medicine is suspicious. Old studies looking at airborne bacteria show, among other things, that women wearing stockings shed more bacteria than women with bare legs [23]. NICE took the stance that handwashing is what is key and clothing with sleeves does not affect bacterial colony counts, but that it could affect practitioners' abilities to wash their hands. This conclusion too has been refuted [7].

Interestingly, the further we dive into the topic of skin squames, the muddier the water seems to get. For example, men shed twice as many bacteria as women, yet there has never been—nor would we advocate for—a restriction on men in the operating room [24]. The release of airborne bacteria from scrub suits and street clothes was studied and found to be nearly equal, yet, again, scrubs remain the standard [25]. In another study, which itself is cited in both the most recent WHO and CDC guidelines, subjects wearing “outdoor clothing” shed fewer bacteria than subjects wearing scrubs [26]. The authors concluded: “Leaving aside considerations of comfort and hygiene of the staff, it is concluded that outdoor clothing need not be removed before entering an operating theatre (or clear area) provided that a gown, mask, etc. are worn.” Another set of studies reached an even more drastic conclusion: Naked men shed approximately a third to a half as many bacteria as the same men wearing street clothes or scrub suits [27, 28]. Perhaps “scrubs” actually live up to their name: rather than “catching” squames, which the skin sheds perpetually, they may in fact be “scrubbing” these bacteria-laden squames from our skin. If we are to adhere to the strict prescription of evidence-based medicine, ought we to disrobe prior to entry into the operating room? We argue no, although for reasons that are outside of how it would affect bacterial counts in the operating room.

### **ENOUGHTO HANG OUR HATS ON?**

On the topic of hats, AORN recommends that “a clean surgical head cover or hood that confines all hair and completely covers the ears, scalp skin, sideburns, and nape of the neck should be worn” and rated the evidence as “level 2: moderate” [1]. Interestingly, the only “evidence” that is cited by AORN for covering the ears and every last bit of hair is that they contain bacteria that might fall into the surgical wound. They agree that there is no evidence of any difference in surgical site infection (SSI) rates, but they refer to the risk of increasing the number of airborne bacteria. As far as we know, this has neither been established nor studied systematically for a very long time.

As argument for their recommendations, AORN cites a report from 1990 published in the *New England Journal of Medicine* that highlighted an outbreak of 20 postoperative wound infections caused by group A *Streptococcus* (GAS) [29]. Extensive testing identified the source as “a technician who entered operating rooms before but not during operations” who had psoriatic lesions on his scalp. It seems that covering the ears and all hair would not have made a difference in this case. Moreover, the same study notes that in 8 of the 12 outbreaks of GAS between 1965 and 1990, the carriers were identified to have the causative bacteria in their rectum or vagina. Another study investigating sternal wound infections cited by AORN concludes: “The patients’ sternal skin was the main source for wound contamination with MRSE [methicillin-resistant *Staphylococcus epidermidis*]” [30]. Other case studies have identified sinusitis and

onychomycosis in healthcare workers as likely contaminants in outbreaks [31, 32]. The logical connection to ears-and-hair-as-culprit remains unclear.

In 1963, a study in 330 clean operations reported that all operating room air samples were positive for bacteria averaging 187 colonies/square foot/hour. There were 22 SSIs (6.7%) and in only one did the SSI organism match bacteria from the air sample. Notably, that organism was also present in the patient’s nose [33]. The authors concluded that “atmospheric contamination was found to be an unimportant factor in the development of wound sepsis.” In fact, it is entirely possible that hats that cover the ears will rub off more skin squames and increase airborne bacteria, although even that may not affect SSI rates. Recently, a large retrospective review by Shallwani et al noted no statistically significant change in the SSI rate from 13 months before to 13 months after the new AORN policies [34]. Given utter absence of evidence supporting this policy and newer evidence refuting it, there is little reason to support the AORN recommendations regarding head covering.

### **GIVE HIM A MASK AND HE WILL TELL YOU THE TRUTH**

On the topic of masks, AORN recommends that “surgical masks in combination with eye protection devices, such as goggles, glasses with solid side shields, or chin-length face shields, must be worn whenever splashes, spray, spatter, or droplets of blood, body fluids, or other potentially infectious materials may be generated and eye, nose, or mouth contamination can be reasonably anticipated” [1]. Here, the debate is less vivacious, but it serves as an example of a habit that is not borne out in the evidence. The AORN guidelines astutely recognize this and note that the surgical mask really serves 2 roles: supposedly protecting the patient and assuredly protecting the providers [1]. We wear surgical masks in the operating room and have been doing so for nearly 100 years [13]. Perhaps this is simply because it’s the way “we’ve always done it” [35]. In 2002, a Cochrane review did not show a significant difference in postoperative surgical wound infection between masked and unmasked providers [16, 36]. In fact, the nonsignificant difference favored *not* wearing a mask. Deep down, surgical masks protect the wearer, and perhaps for that reason, no one is rushing to remove them. However, masks have never been shown to be helpful in reducing SSIs [35, 37, 38].

In sum, the data are conflicting or at least suggest practices that may be of marginal benefit but fly in the face of societal norms (again, think of naked surgeons without face masks). Moreover, there are other considerations when mandating a policy in the hospital aside from direct effects on infection control: how patients perceive their caretakers, how caretakers interact with one another, and how efficiently patients move through the system [7, 39]. Male caretakers still wear ties, female practitioners wear jewelry, and both wear white coats,

although from a strict infection control standpoint, some have advocated that we should abolish these habits [6, 40, 41]. Yes, there are other factors at stake: Patients prefer their physicians to look the part!

From the standpoint of infection control, should we require surgical caps to cover the ears and *all* hair? It's tough to say, but the data do not suggest so. Is it right to remain naked beneath surgical gowns? Not as far as employee satisfaction is concerned. We suggest a balanced approach to operating room attire policies that considers the data, the lack of data, and ancillary factors that affect the patient and provider experience.

## Notes

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